

# SWIM Connect 2015

Information Sharing in  
Commercial Space:

*Space Vehicle Operations*  
*SWIM for Launch and Reentry*  
*Operations*

Kevin Hatton  
SVO Program Manager, ANG-C54

November 4, 2015



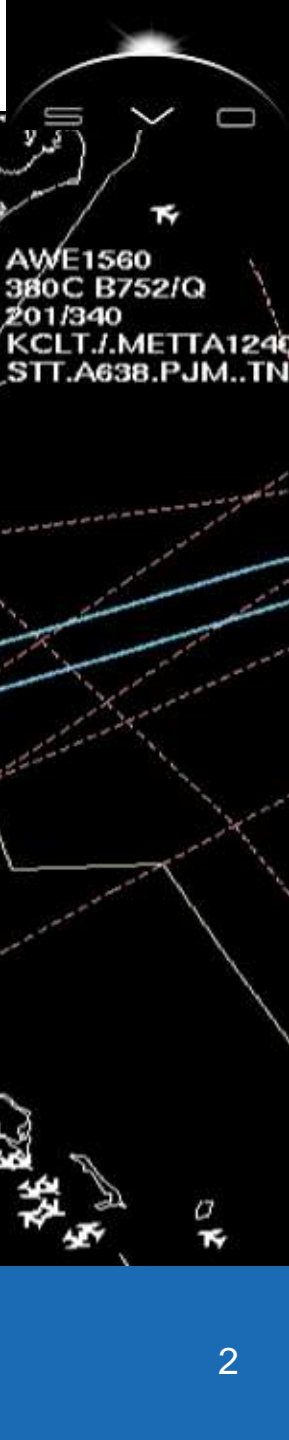
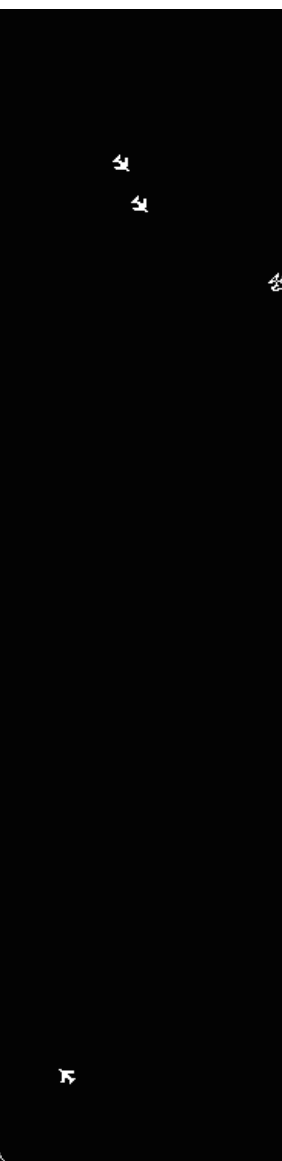
Federal Aviation  
Administration

**SWIM**  
connect 2015

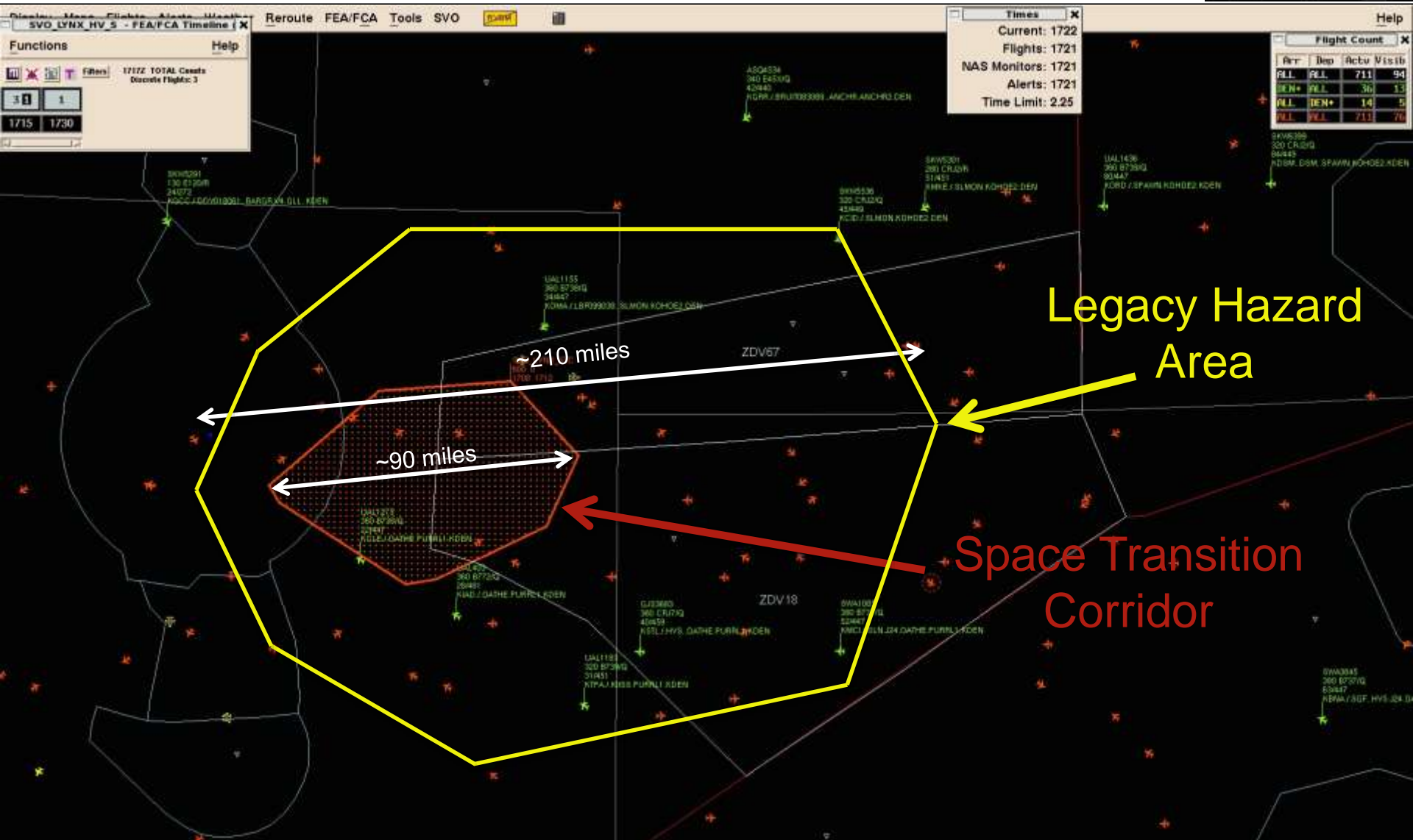
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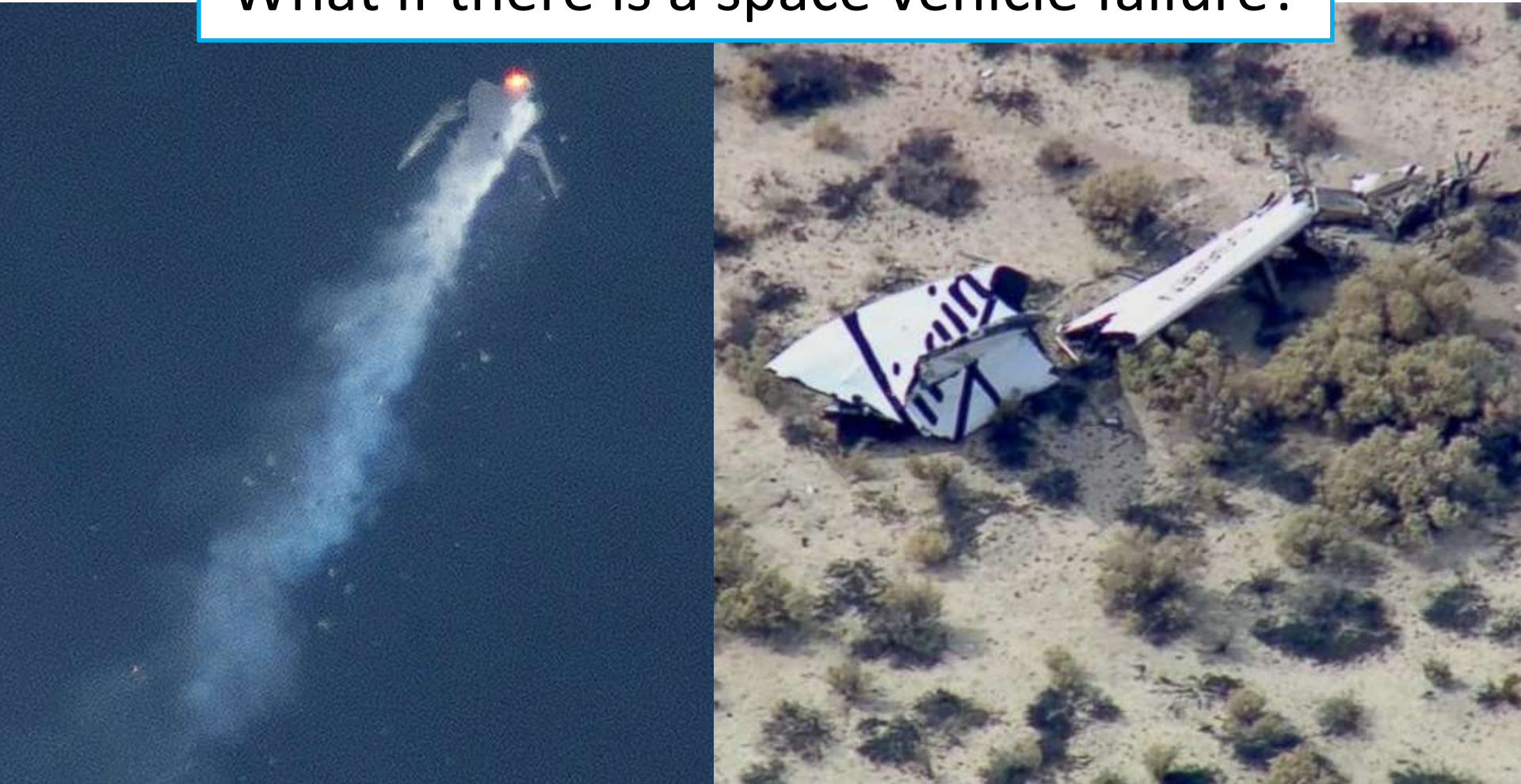


# STC vs. Legacy Hazard Areas



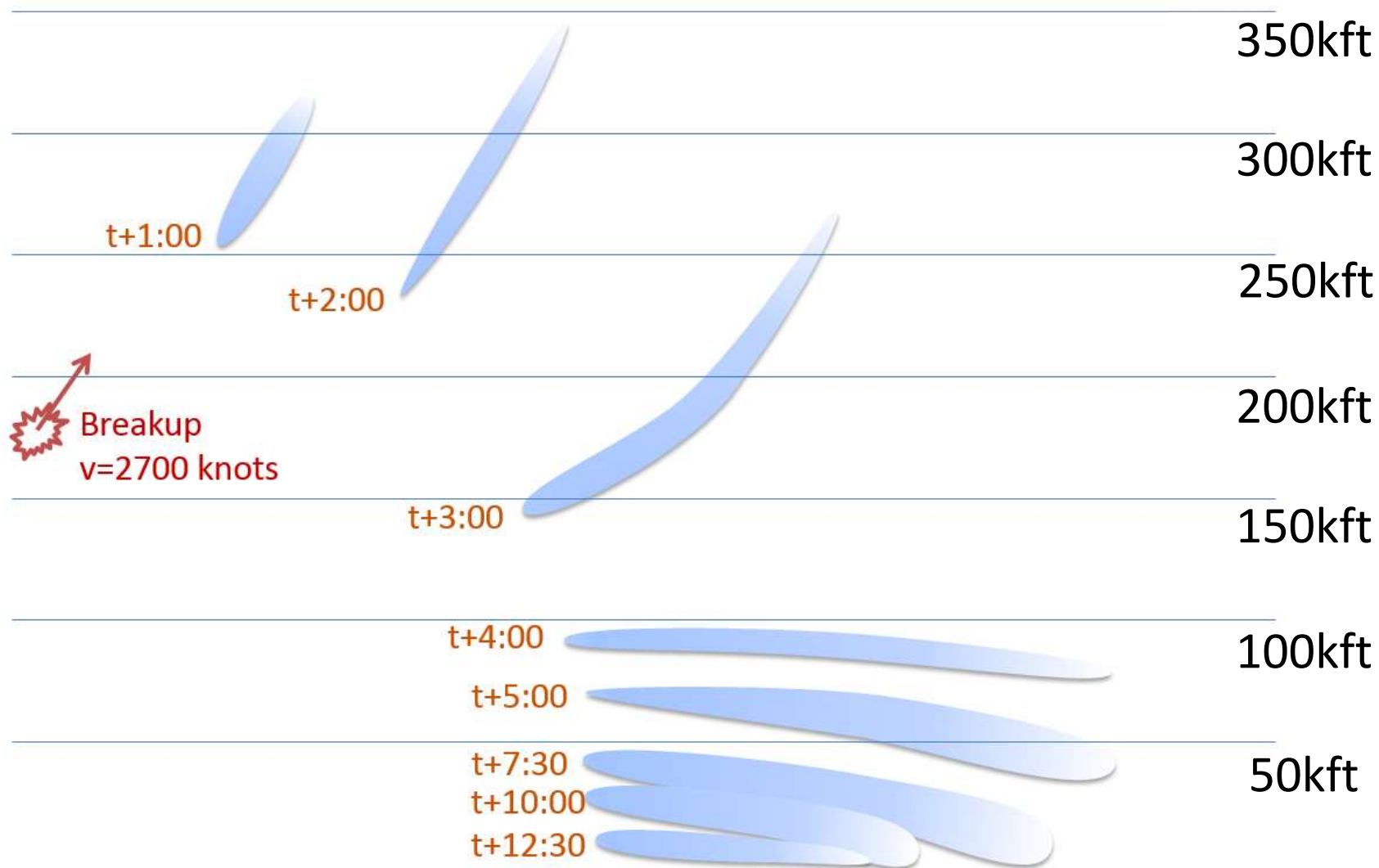


# What if there is a space vehicle failure?

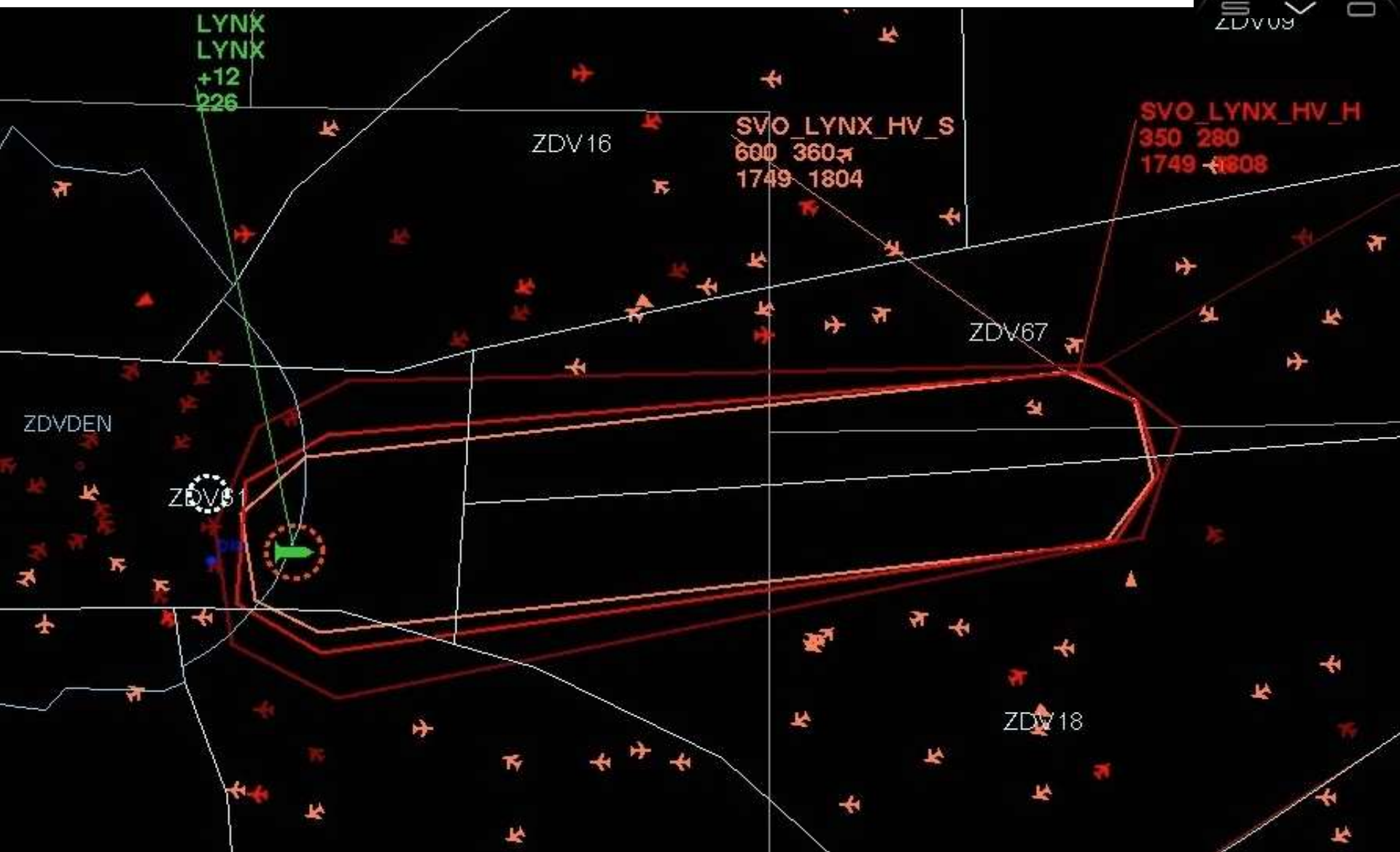


Spaceship 2 Structural Failure, October 31, 2014

# Debris Fall from HITL Launch Failure



# SVO Human-in-the-Loop



# SWIM Services



- Dynamic SAA – Input from operators in real time allows improved communication and data sharing
- Space Transition Corridor (STC) & Debris Hazard Volume (DHV) available to subscribers
  - FAA
  - AOC
  - Flight Deck
  - Spaceport
  - Space Vehicle Operator

# Potential Operator-Provided Information



- Estimated ANSP entry time (landing)
- Estimated ANSP exit time (launch)
- Fuel type (solid, liquid, etc)
- Number of stages (or jettisons)
- Number and Types of engines
- Payload details
- Vehicle type (e.g., expendable or reusable)
- Mission type (e.g., orbital or suborbital)
- Space Vehicle Operator
- Nominal and Off-Nominal Hazard area
- Debris catalog



# SWIM Connect 2015

## Information Sharing in Commercial Space: *Space Data Integrator*

By: Dan Murray  
Office of Commercial Space Transportation,  
FAA

Date: November 4, 2015

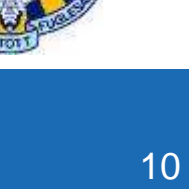


Federal Aviation  
Administration

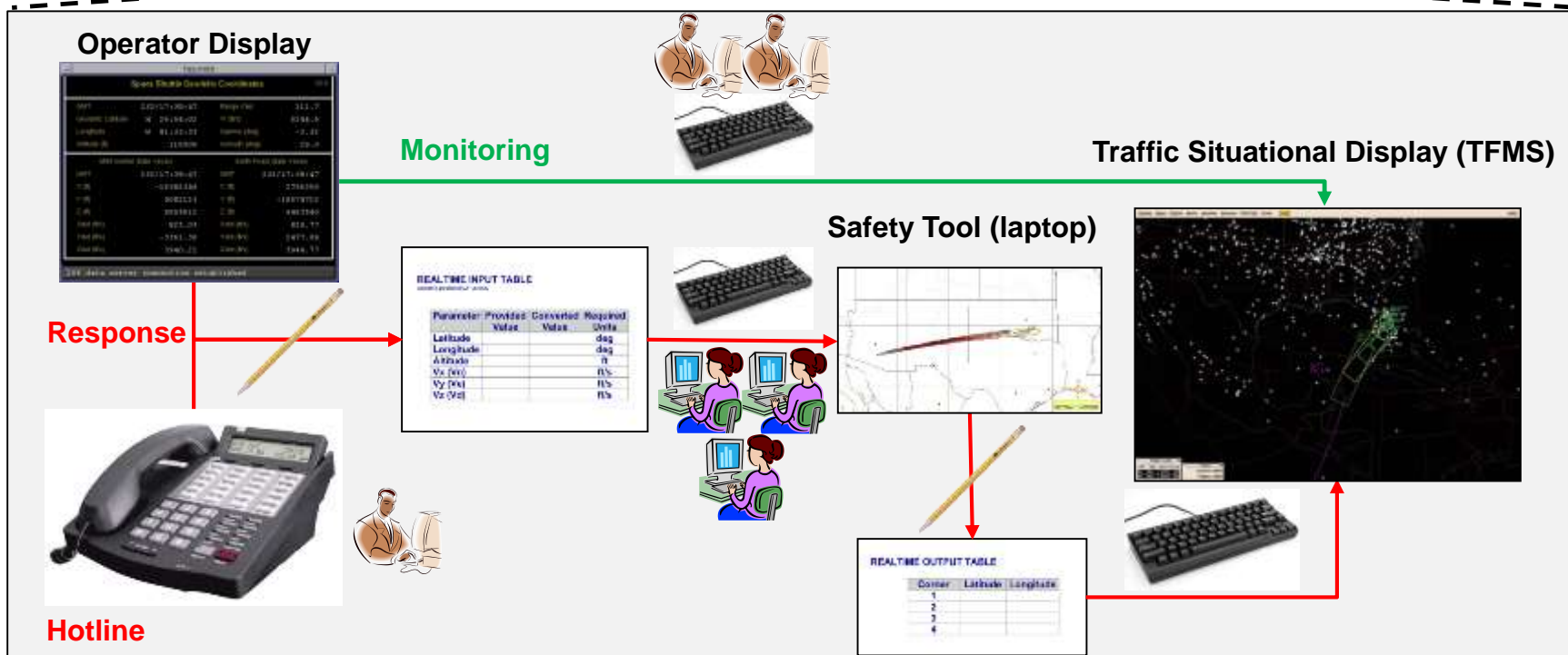
The logo for SWIM connect 2015 is located within a large white circle on a blue background. It features the word "SWIM" in a bold, black, sans-serif font. To the right of "SWIM" are three blue circles of varying sizes. Below "SWIM" is the text "connect 2015" in a smaller, black, sans-serif font. The background of the slide features a blue gradient with several overlapping circles in different shades of blue.



- FAA directly supported NASA on all 22 Shuttle missions since STS-114 in August of 2004
- Lessons learned pointed to the need for an FAA capability to increase its situational awareness during launch and reentry, and:
  - Accurately model a launch/reentry vehicle failure
  - Identify potentially affected airspace
  - Assess impacts on air traffic
  - Quickly distribute information to affected parties

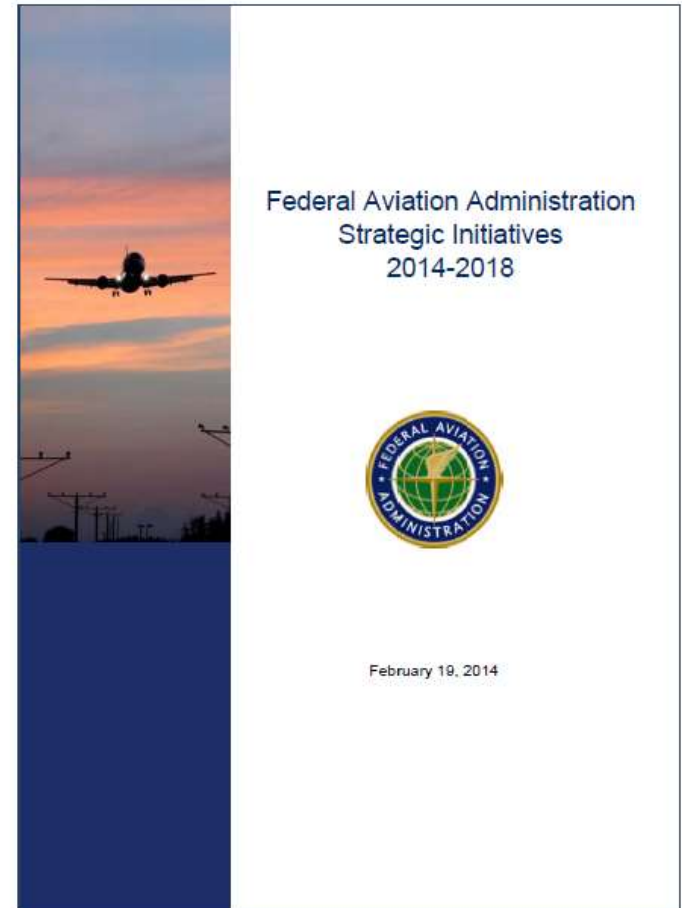


# Current Capabilities: Reentry from Orbit



# FAA Administrator's Strategic Initiatives

- [http://www.faa.gov/about/plans\\_reports/media/aa\\_strategic\\_initiatives\\_summary.pdf](http://www.faa.gov/about/plans_reports/media/aa_strategic_initiatives_summary.pdf)
- Over the next several years, the FAA is committed to making measureable and steadfast progress toward a vision for transforming the aviation system to reflect the highest standards of safety and efficiency, and to be a model for the world.
- Initiatives lay the foundation for the aerospace system of the future
- Commitment to delivering benefits through technology and infrastructure, including “New Entrants - Commercial Space”





# Space Data Integrator (SDI) Project

- Purpose: Demonstrate the benefits of automating the manual processes currently used by the FAA Joint Space Operations Group during commercial launch and reentry operations to distribute mission related information
- Approach: Develop a prototype launch and reentry space vehicle data integrator capability that provides time accurate data for:
  - Automated situational awareness
  - Monitoring of space launch/reentry vehicle transitions through the NAS
  - Notice and response to off-nominal scenarios
- Goal: Define requirements for near term operational capabilities that will integrate commercial launch and reentry vehicle data into current FAA systems

# SDI Elements

- **Space Data Integrator (SDI) Server**
  - Build a valid flight plan using trajectory info provided by launch/reentry vehicle operator
  - Convert incoming, time-accurate launch/reentry vehicle operator telemetry state vector data into:
    - Position messages for input to Traffic Flow Management System
    - State vectors for input to aircraft hazard area computation tool
    - Vector and mission event data for display
- **Enhanced Space Data Display (ESDD)**
  - Display data from launch/reentry operator that cannot be displayed in current FAA systems:
    - Predicted/actual position, impact points, and traces
    - Countdown timers for key mission events
    - Indicators of data connectivity and quality
  - Monitoring these parameters provides FAA with early indication of off-nominal conditions

# Enhanced Space Data Display

## Event List

Deorbit Burn Start		
Predicted UTC	057:14:10:36	T+00:00:00
Actual UTC	057:14:10:36	T+00:00:00
Deorbit Burn Stop		
Predicted UTC	057:14:10:50	T+00:00:00
Actual UTC	057:14:11:20	T+00:00:30
Loss of Signal		
Predicted UTC	057:14:11:41	T+00:00:00
Actual UTC	057:14:11:41	T+00:00:00
Acquisition of Signal		
Predicted UTC	057:14:13:09	T-00:00:00
Actual UTC	057:14:12:49	T-00:00:20
Hazard Area Active		
Predicted UTC	057:14:11:55	T+00:00:00
Actual UTC	057:14:11:55	T+00:00:00
Splashdown		
Predicted UTC	057:14:18:32	T-00:02:18
Actual UTC	000:00:00:00	T-00:02:18

## Status Lights

SpaceX Recent

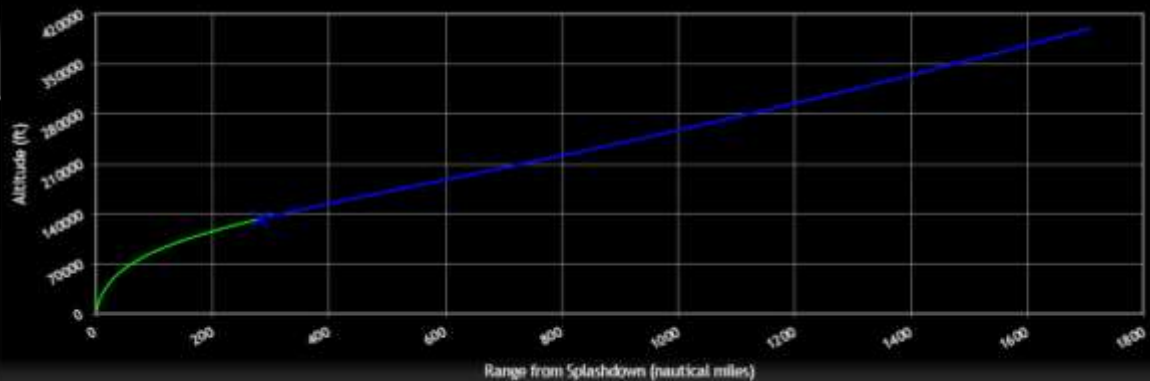
Receiving SpaceX

## Map

Display \* Overlays \* Options \* Source Options \* Hazard Areas \*



## Altitude vs Range



# SDI Elements

- TFMS Traffic Situation Display (TSD)
  - Display predicted route of flight based on flight plans submitted via SDI
  - Display launch/reentry vehicle current position based on messages submitted via SDI
  - Move Range Risk Analysis Tool (RRAT) output Aircraft Hazard Areas (AHAs) to TFMS and convert to Flow Evaluation Area (FEA) format for recall on TSD
  - Display AHAs as FEAs





# Remaining Schedule for Demonstration

1/23/15: Complete System Engineering and Trade Study Document

1/28/15: Purchase SDI Demonstration Hardware

Feb-Mar: Software Development and Test

5/29/15: Complete Integration Testing

7/3/15: Complete On-site Testing (FAA Command Center)

7/28/15: Ready for Operational Demonstration

TBD: Operational Demonstration during upcoming Dragon reentry



# Partners



- Office of Commercial Space Transportation (AST)
- Air Traffic Organization (ATO)
  - System Operations
  - Mission Support
  - Technical Operations
- NextGen (ANG)



Millennium Engineering  
and Integration Company



CGH Technologies



Advanced Sciences &  
Technologies

# Questions?

AVIATION WEEK  
& SPACE TECHNOLOGY

Daily Updates, Access Anywhere  
Now online and in NEW mobile app

## SpaceX Dragon Helping FAA Free Up More Airspace

John Croft | Aviation Week & Space Technology

May 22, 2015

### AIR TRAFFIC MANAGEMENT

## Space Chase

Dragon data to hone airspace tool

John Croft Atlantic City, New Jersey

**T**he FAA is beta-testing a new air traffic tool with the help of data from SpaceX's Dragon spacecraft, a task that signals a major shift in how the agency will manage restricted airspace around future space launches and reentries.

The effort is meant to limit the size and amount of time airspace remains off limits to commercial airlines or other National Airspace System (NAS) users during space vehicle ascent or return operations, as well as to automate the non-optimal procedures that air traffic controllers now perform by hand during a launch or reentry. SpaceX and the FAA are partners in the project.

Limiting the effects of space operations on U.S. airspace is seen as critical, as the FAA expects a drastic increase over several years from now in the pace of orbital and suborbital launches—an increase in the U.S. alone to one launch daily, from approximately once per month. Fueling the action is a budding commercial space sector that plans to begin offering a plethora of services, from manned suborbital joyrides and high-altitude balloon ventures to air-dropped or vertical launch of new breeds of small satellites and miniature “nanosatellites.”

The FAA issued permits for 23 commercial space launches in 2014, up from 18 in 2013, and three in 2012—but indicates slow the tempo of the launch and reentry operations accelerating.

The agency identifies the airspace that could be affected by a launch or reentry and how long it could be affected—expanding the bounds of the area to consider possible contingencies—and shuts down the area to keep out air traffic for the duration of the planned event. During the activity, a Joint Space Operations Group working at the FAA's Air Traffic Control Systems Command Center in Warrenton, Virginia, manually keys in position updates and evolving hazard areas from the launch or reentry vehicle into the traffic management system for a situational display that FAA air traffic managers use for

tactical and strategic decisions in case contingencies occur.

“We’re starting to see a significant increase in the frequency of spaceflight operations, so that model won’t work anymore,” says Daniel Murray, manager of the FAA's Space Transportation Development Division. “In the past, there were only a couple of places in the country where a launch could take place—coastal locations where there is an opportunity to get out over water quickly—and given that there were only 6-12 launches a year, there was not a big emphasis on the effects on the NAS.” Murray was discussing the application at the Air Traffic Control Association's Technical Symposium in Atlantic City, New Jersey, in May.

The FAA solution, called the Space Data Integrator (SDI), automates the manual process by ingesting telemetry data from vehicle tracking systems and sending the information directly to a traffic flow management situational display where the current and projected positions, as well as the projected areas where airspace must be protected, are plotted and managed.

“Right now, we compute what we think the hazard area will be, and we compute it so large that it will accommodate a number of different types of contingencies,” says Murray. “Then we put that in place, and we leave it in place for the duration of the launch or reentry. This automation will allow us to more dynamically tailor the airspace so that the only airspace that's protected is the airspace that actually would be affected.”

The FAA tested SDI at the agency's Atlantic City Technical Center facility in early May and is working with SpaceX to replay mission data from previous Dragon reentries through the system in anticipation of a live event during a future space station resupply mission.

“That will entail our Joint Space Operations Group working the mission in real time, on an isolated system, we have our prototype running in parallel... to demonstrate the benefits,” Murray says.

The FAA also is developing processes and procedures for air traffic managers and controllers to use the information, he says. “When we move away from... treating these as special operations and moving them into more routine operations—something an air traffic controller could see on a fairly regular basis—the procedures and policies would be in place and tested and training would be in place,” Murray says. ■



SpaceX Dragon capsule reentry data are helping the FAA test a new tool that trims restricted airspace.

48 AVIATION WEEK & SPACE TECHNOLOGY/JULY 20/AUGUST 6, 2015

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# Questions / Discussion